Sub Spec
G(N B)

MARKED UP SPEC--**09/800,871**
EQUAL RESPONSE AXLE

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects and advantages of this invention may be more clearly seen when viewed in conjunction with the accompanying drawings wherein:

FIG. 1 is a representation of the dimensions employed in Step 2 of the detailed description; [and]

FIG. 2 is a diagrammatic view of the elements of Step 5 in the detailed description, and;

FIG. 3 is a schematic top view of a vehicle with the unique axles.

DETAILED DESCRIPTION OF THE INVENTION

This invention relates to equal response axles for vehicles 10 having a front engine 15 and a rear wheel drive (non-independent suspension) and is particularly suited for use on racing cars. The invention involves a method and design for equalizing the torque at the tire contact patch. The engine 15 is connected through a transmission 16 to a drive shaft 17 which drive the axels 13 and 14.

Accordingly, the right and left axles 13 and 14 are machined to different dimensions based on a formula for calculating spring rates (tortional stiffness) of torsion bars. Basically, the calculation uses the static loaded radius (dimension from center of axle to ground) using either static or dynamic weight on the tire (portion of tire flat on the ground).

In Step 1, the polar moment of inertia (1) for a tubular bar is calculated as follows:

STEP 1

Solid Bar	Tubular Bar
$J=\frac{\Pi D}{32}$	$J=\frac{\Pi (D_1^4-D_2^4)}{32}$

where J=Polar moment of inertia
D=Diameter of bar

D_1=outer diameter
D_2=inner diameter

In Step 2, reference should be made to FIG. 1 for the various parameters.

STEP 2

$$F=\frac{W \times L}{L}$$

where F=T
F=force
T=torque

STEP 3

$$\theta=\frac{T \times L}{G \times J}$$

where w=a select weight
F=force in pounds
T=torque in pounds
J=polar moment
G=modules of elasticity in shear (PSI)
L=working length of bar

Note:

(1) For W use 500 pounds for 1 inch or larger bars

(2) Use 10,750,000 for G with 4140 steel

(3) Answer will be in radians

STEP 4

Multiply the answer in Step 3 by 57.3=Degrees of twist

Refer to FIG. 2 for an understanding of Step 5

STEP 5

(a) Draw a line using torsion arm length.

(b) Draw a second line of the same length representing degrees of twist.

(c) Divide the load by the distance.

STEP 6

Divide the load by the distance

Load=W=500
Distance=2 7/16

$$\frac{L}{D} = \frac{500}{2\ 7/16} = 205 \text{ inch pounds}$$

Using the above formula to dimension the rear axles on high performance or racing cars overcomes the problems associated with an unequal response as torque is delivered unequally to the rear wheels 11 and 12. The problems are caused by the instantaneous weight transfer to the left rear wheel 11 and the fact that the right side axle 13 is longer than the left side 14, yet both conventionally have the same diameter in the effective length of the axle. The fact that the left side axle 14 is shorter with the same diameter means that the left rear wheel 11 will lose traction first under hard acceleration because the shorter axle 14 has a high spring rate (tortionally stiffer), and the longer axle 13 will twist slightly before spinning the wheel 12. If the right and left axles 13 and 14 are machined to different dimensions determined by the foregoing formulas the problems are overcome. This invention uses the static loaded radius (dimension from center of axle to ground) using either straight static or curved dynamic weight on the tire.

If you are going through a left hand corner and the car has a slight under steer, a softer left rear axle 14 can fix this problem. Also, if you going through a right hand corner under power you must be much more careful not to spin out than if it was a left hand corner. There is a torque reaction that takes weight off the right rear wheel 12 and applies it to the left rear wheel 11. The weight transfer going through a right hand corner is also transferring weight to the left side wheels 11 together. This is loading up the left rear wheel 11 to the point where spinning out becomes all too easy. However, with the proposed "kera" axles, if you choose to replace the left rear axle 14 with a smaller diameter, (softer spring rate in twist), the instantaneous weight

transfer can be softened (absorbed) in the twisting action of the axle 14 which will result in more grip on the race track.

Applications particularly suited for the invention occur in oval track racing cars, open wheel cars, road racing cars, off road racing vehicles, high performance street cars, sport utility vehicles, pick-up trucks and commercial trucks and buses on all live axle rear wheel drive passenger cars.

In drag racing, the "kera" sized axle will allow more even distribution of power under acceleration. Axle sizing is an excellent way of tuning the chassis under acceleration. The "kera" sized axle also helps prevent breakage of drive train parts.

The general advantages for all road vehicles include:

1) Less wheel spin under acceleration;

2) More even application of torque to drive wheels (even wear);

3) Less breakage in drive train;

4) Better response under starting acceleration;

5) Better grip when applying power through corner;

6) More even deceleration;

7) Better drive wheel tire wear.

While the invention has been explained by a detailed description of certain specific embodiments, it is understood that various modifications and substitutions can be made in any of them within the scope of the appended claims, which are intended also to include equivalents of such embodiments.

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